E C O N O M I C S   B U L L E T I N

Incomplete Information, Renegotiation, and Breach of Contract

Jihong Lee
Birkbeck College, University of London

Abstract

Once a contract has been agreed by two agents, the problem of renegotiating breach under two−sided asymmetric information on the agents' outside options is equivalent to the problem of bilateral trade with uncertain gains. Thus, the theorem of Myerson and Satterthwaite (1983) implies the impossibility of efficient renegotiation. We also show that, assuming no renegotiation, the optimal breach mechanism in this setting corresponds to the expectation damage rule.

The author thanks Hamid Sabourian for his comments.
Citation: Lee, Jihong, (2005) "Incomplete Information, Renegotiation, and Breach of Contract." *Economics Bulletin*, Vol. 3, No. 5 pp. 1−7
Submitted: July 22, 2004. **Accepted:** January 22, 2005.
URL: http://www.economicsbulletin.com/2005/volume3/EB−04C70013A.pdf

1 Introduction

Fluctuating market conditions sometimes render existing contractual relationships inefficient. This note investigates the role of incomplete information in determining the scope of contracting when efficient contract breach is possible. When long-term relationships and contracts matter, market mechanisms may not respond efficiently to unfolding circumstances if there is incomplete information.

The setting is as follows. There are two agents who face a prospect of a long-term relationship that generates a (nonstochastic) surplus.[1] The surplus materializes if and only if the relationship is maintained throughout the duration. After the relationship begins, the agents privately learn the (stochastic) values of their outside options. On average, each agent's share of the relationship surplus is greater than his outside value (and thus pursuing the relationship is ex ante efficient). But, there is also the possibility that the sum of the outside values turn out to be greater than the relationship surplus.

First, we ask, assuming that there exists a binding contract, what can be achieved by renegotiation. We notice that the problem of renegotiating contract breach here is identical to the problem of bilateral trade with uncertain gains, a well-studied problem in the Bayesian mechanism design literature. Any efficient renegotiation process must be *interim individually rational* because some efficient breach opportunities will otherwise be lost. Thus, we can directly apply the theorem of Myerson and Satterthwaite [6] (or simply MS) and state the impossibility of efficient renegotiation.

Much of the established literature on contract theory is based on the premise that renegotiation can always exploit any inefficiency remaining after a contract has been written. While this may be a reasonable description of a complete information setting, a simple re-interpretation of the MS result demonstrates that it does not necessarily apply to an incomplete information setting.[2]

Second, instead of renegotiation, we consider standard breach mechanisms (that specify a fixed compensation paid by the breacher) and show that the optimal rule of such kind under incomplete information corresponds to the expectation damage rule. This result complements the existing literature on the issue of optimal breach remedies, which has been mostly concerned with the question of ex ante efficiency, i.e. inducing a correct level of relationship-specific investment (reliance), when information is complete (and hence renegotiation is assumed to make the ex post outcome always efficient). See, among others, Shavell [8], Rogerson [7], Chung [2],

[1] There is no relationship-specific investment.

[2] Hall and Lazear [5] consider a similar problem in the employment context. They show that many "realistic" employment contracts are written such that when the worker's outside value and the firm's valuation of the worker are private information, there are too many layoffs and quits.

Spier and Whiston [9], Edlin and Reichelstein [4], and Edlin [3].

Our results are also related to the work of Aghion and Bolton [1] (and Spier and Whinston [9]) who consider endogenously determined breach remedies in a supplier-buyer relationship. Efficient breach is possible as a new supplier enters the market with a cost advantage, but it is shown that when the future entrant has some market power the buyer and the incumbent seller will set a socially excessive level of penalty for breach, thereby reducing the likelihood of entry below the ex post efficient level.

This note is organized in as follows. In Section 2, we present a model of contract breach. In Sections 3 and 4, we present the results. Finally, some concluding discussion is given in Section 5.

2 A Model of Contract Breach

Let us describe a model of contract breach with incomplete information. Consider a situation in which two (risk-neutral) agents, indexed by $i = 1, 2$, face the opportunity to engage in a long-term relationship and generate a positive and verifiable surplus of X. At $t = 0$ the agents must decide whether or not to undertake the relationship whose surplus comes about at some future date $t = 2$. The distribution of this surplus is pre-determined. Let x_i denote agent i's share, where $x_1 + x_2 = X$.

If the agents do not pursue this joint venture from $t = 0$ through $t = 2$, the relationship surplus X does not materialize; instead they get their reservation utilities, denoted by r_1 and r_2 respectively for agents 1 and 2, which are independently and randomly drawn from the domains $[0, \bar{r}_1]$ and $[0, \bar{r}_2]$.

As is the case with the relationship surplus X, these reservation utilities accrue to the agents at $t = 2$ if the agents do not pursue the relationship. But, they privately learn their respective outside values at some time between $t = 0$ and $t = 2$, say, at $t = 1$. Let $f_i(\cdot)$ and $F_i(\cdot)$ be the probability density function and the corresponding cumulative distribution function of agent i's reservation utility. We assume that each $f_i(\cdot)$ is strictly continuous and positive on its domain $[0, \bar{r}_i]$. Also, let r_i^e be the expected reservation value of agent i.

We first assume that

$$x_1 > r_1^e \text{ and } x_2 > r_2^e \tag{1}$$

Thus, engaging in the relationship is ex ante efficient.

Second, we have

$$X < \bar{r}_1 + \bar{r}_2 \tag{2}$$

This implies that sometimes ex post efficiency entails the agents pursuing their outside options and obtaining their reservation utilities. The *efficient breach rule* calls for the agents to pursue their relationship if X exceeds the sum of their reservation utilities $r_1 + r_2$ and to pursue their individual outside opportunities otherwise.

Third, we restrict the analysis to the case in which

$$x_1 \geq \bar{r}_1 \quad \text{and} \quad x_2 < \bar{r}_2 \tag{3}$$

Only agent 2 faces the possibility of wanting to breach.

3 Inefficient Renegotiation

Assume that a binding contract is available to protect the relationship. Once written, it prohibits the agents from walking out of the relationship. The risk-neutral agents will want to install such a contract ex ante, but it is ex post inefficient. Let us now consider what can be achieved by renegotiation between date 1 and date 2. We shall not impose a particular renegotiation process; rather we shall ask what can be achieved by *any* renegotiation process here.

We notice that the renegotiation problem in this setting is identical to the well-known problem of bilateral trade with incomplete information. Agent 2 may want to buy himself out of the relationship, but the gains from such trade is uncertain. After the agents observe their reservation utilities at date 1, their private valuations of this good, i.e. termination of the contract, are $v_1 = x_1 - r_1$ and $v_2 = r_2 - x_2$ respectively for agents 1 and 2. Efficiency requires termination of the contract if and only if $v_2 > v_1$ (or $r_1 + r_2 > X$).

Define the intervals on these (random) valuations by $v_1 \in [v_1^o, v_1']$ and $v_2 \in [v_2^o, v_2']$. Notice that if $r_2 < X - \bar{r}_1$ (i.e. $v_2 < x_1 - \bar{r}_1$) and/or $r_1 < X - \bar{r}_2$ (i.e. $\bar{r}_2 - x_2 < v_1$) breach cannot possibly be efficient. Thus, without loss of generality, let $v_2^o = x_1 - \bar{r}_1$ and $v_1' = \bar{r}_2 - x_2$.[3]

We draw attention to two critical aspects of the problem. First, any efficient renegotiation process must be *(interim) individually rational*; that is, having observed his private information, each agent must *always* expect to become at least as well off from participating in the renegotiation process as not participating and enforcing the existing contract. Otherwise, in some instances efficient breach opportunities will be foregone. Second, the revelation principle dictates that, for any Bayesian equilibrium of any renegotiation (bargaining) process, there exists an incentive-compatible *direct-revelation mechanism* that induces the same outcome. Thus, in considering the scope of renegotiation in our model, we incur no loss of generality by restricting attention to the set of direct-revelation mechanisms that are incentive-compatible and individually rational.

[3]We can assume, in the spirit of a tie-breaking convention, that agent 1 will never want to renegotiate unless $v_1 \leq \bar{r}_2 - x_2$ and similarly agent 2 will never want to renegotiate unless $v_2 \geq x_1 - \bar{r}_2$.

A (direct-revelation) *renegotiation mechanism* is $m = [q(v), t(v)]$ where $v = (v_1, v_2)$ is the agents' announcements on their valuations of terminating the contract, $q(v)$ is the probability of termination, and $t(v)$ is the transfer from agent 2 (buyer) to agent 1 (seller). Let M denote the set of all such mechanisms. For notational simplicity, let $q \equiv q(v)$ and $t \equiv t(v)$.

Given a renegotiation mechanism $m = [q, t]$, let $t_i^m(v_i)$ be agent i's expected payment/receipt from playing the mechanism given v_i. Similarly, let $q_i^m(v_i)$ be the same agent's expected probability of trade given v_i. We can then define the agents' interim expected utilities from participating in m:

$$\begin{aligned} U_1^m(v_1) &= t_1^m(v_1) - v_1 q_1^m(v_1) \quad \text{and} \\ U_2^m(v_2) &= v_2 q_2^m(v_2) - t_2^m(v_2) \ . \end{aligned}$$

Thus, given v_1 and v_2, renegotiation m occurs if and only if

$$U_1^m(v_1) \geq 0 \text{ and } U_2^m(v_2) \geq 0$$

The mechanism is individually rational if and only these two inequalities is true for *every* $v_1 \in [v_1^o, v_1']$ and for *every* $v_2 \in [v_2^o, v_2']$.

A mechanism $m = [q, t]$ is incentive-compatible if and only if we have, for every $v_1, \tilde{v}_1 \in [v_1^o, v_1']$,

$$U_1^m(v_1) \geq t_1^m(\tilde{v}_1) - v_1 q_1^m(\tilde{v}_1)$$

and for every $v_2, \tilde{v}_2 \in [v_2^o, v_2']$,

$$U_2^m(v_2) \geq v_2 q_2^m(\tilde{v}_2) - t_2^m(\tilde{v}_2) \ .$$

Let $M^r \subseteq M$ denote the set of renegotiation mechanisms that are incentive-compatible and individually rational.

Now, define $q^* \equiv q^*(v_1, v_2)$ as

$$\begin{aligned} q^* &= 1 \ \text{ if } v_1 < v_2 \\ &= 0 \ \text{ otherwise} \end{aligned}$$

We can simply re-state the MS theorem here.

Proposition 1 *There exists no $m = [q, t] \in M^r$ such that $q = q^*$.*

Proof. See Myerson and Satterthwaite (1983). We only need to check that $[v_1^o, v_1'] \cap [v_2^o, v_2'] \neq \emptyset$.

We know that

$$\begin{aligned} v_1 &\in [x_1 - \bar{r}_1, \bar{r}_2 - x_2] \quad \text{and} \\ v_2 &\in [x_1 - \bar{r}_1, \bar{r}_2 - x_2] \ . \end{aligned}$$

Since $\bar{r}_1 + \bar{r}_2 > x_1 + x_2$, we have $\bar{r}_2 - x_2 > x_1 - \bar{r}_1$. $\|$

This implies that there exists *no* renegotiation process that will implement the efficient breach rule in our setting.[4]

4 Standard Damage Measures

A contract may include a *breach mechanism* that agent 2 can enforce should he want to walk out of the relationship after observing the value of his outside option. This mechanism can in principle be a sophisticated one (a revelation mechanism for instance), but typically we observe some fixed number, an amount that breacher can pay the other party to let himself free of the relationship. Let us refer to this type of simple breach mechanism as *standard damage measure* that specifies a number T where $T \in \Re^+$.

Sometimes breach mechanisms are not privately stipulated, but rather, *court-imposed*. There are three commonly observed types of court-imposed standard damage measures.

First, *expectation damage* levies a compensation from the breacher that makes the non-breacher as well off as he would have been if the relationship had been completed. In the present setting, each agent obtains his reservation utility if the relationship is not pursued. Since the reservation utility is private information, expectation damage can be thought of as $T = x_1 - r_1^e$. Second, *specific performance* forces the relationship to be completed (unless the agents mutually agree/renegotiate to terminate it before completion). Thus, specific performance amounts to a prohibitively large value for T. Third, *reliance damage* gives the non-breacher the amount he has spent on reliance, thereby putting him back to his position prior to the relationship. This applies to the case in which the relationship surplus depends on some ex ante investment. If for instance the non-breacher incurs an investment cost of e, then reliance damage amounts to $T = e$.[5]

Now, let us consider what a standard damage measure can achieve instead of renegotiation. Clearly, there exists no single value T that will implement the efficient breach rule. Let us solve for the optimal value of T, that is, the value of T that maximizes the total ex post surplus.

Agent 2 will pay the amount T and free himself of the contract if and only if $r_2 - T \geq x_2$. Let $\pi(T)$ be the expected total surplus as a function of T. This

[4]MS also characterize the mechanism that is interim individually rational and maximizes the total expected gains from trade. In such a mechanism, there will be too little trade.

[5]Reliance damage, however, may not be implementable if e is not verifiable. When the breach is occurring, $X(e)$, the relationship surplus which is a function of the investment, will not have been materialized either, so there will be nothing that the court can infer e from.

amounts to

$$\begin{aligned}\pi(T) &= X\int_0^{x_2+T} f_2(\cdot)dr_2 + \int_{x_2+T}^{\bar{r}_2} (r_1^e + r_2)f_2(\cdot)dr_2 \\ &= r_1^e + (X - r_1^e)F_2(x_2+T) + \int_{x_2+T}^{\bar{r}_2} r_2 f_2(\cdot)dr_2 \ .\end{aligned}$$

We want to maximize this with respect to T bounded in the region $[0, \bar{r}_2 - x_2]$. The upper bound comes from the fact that if T is too high it will never be paid. Let us define $T^* = \arg\max \pi(T)$.

It turns out that the optimal mechanism is the expectation damage.

Proposition 2 $T^* = \min[x_1 - r_1^e, \bar{r}_2 - x_2]$.

Proof Using the formula

$$\frac{d}{dt}\int_{g(t)}^{h(t)} f(x)dx = f(h(t))h'(t) - f(g(t))g'(t)$$

we can derive

$$\pi'(T) = (x_1 - r_1^e - T)f_2(x_2 + T)$$

and

$$\pi''(T) = (x_1 - r_1^e - T)f_2'(x_2 + T) - f_2(x_2 + T) \ .$$

So, setting $T^* = x_1 - r_1^e$ gives the unique (global) maximum since $\pi'(x_1 - r_1^e) = 0$ and $\pi''(x_1 - r_1^e) = -f_2(x_1 - r_1^e) < 0$. (Setting $f_2(x_2 + T^*) = 0$ cannot be another solution since $f_2(\cdot)$ is strictly positive.) Note that $x_1 - r_1^e > 0$ by assumption, so $T^* = x_1 - r_1^e$ or $\bar{r}_2 - x_2$ depending on the parameters as in the claim. $\|$

5 Discussion

When efficient contract breach is possible and the values of the agents' outside options are private information, we cannot attain the ex post efficient outcome, that is, terminating the contract and relationship if and only if the sum of the agents' reservation utilities exceed the relationship surplus, via any renegotiation process. We also show that, amongst the standard damage measures, the expectation damage maximizes the total expected surplus.

Having said this, there actually is a case for third-party intervention, perhaps by the court, to force the efficient outcome using a subsidy. This result is laid out in MS's Theorem 3. MS extend their analysis to consider an arbitrator of the direct-revelation mechanism who can be a net source or sink of money (but cannot own the traded object). Consider a breach mechanism with such an arbitrator characterized by three outcome functions $[t_1(v), t_2(v), q(v)]$ where $t_1(v)$ is the payment from the arbitrator to agent 1, $t_2(v)$ is the payment from agent 2 to the arbitrator, and $q(v)$ is the probability of contract termination. MS solve for the set of such mechanisms that are incentive-compatible and individually rational, and show how much subsidy is required from the arbitrator to implement the efficient outcome.[6]

References

[1] Aghion, P., and P. Bolton (1987) "Contracts as a Barrier to Entry," *American Economic Review*, 77, 388-401.

[2] Chung, T-Y. (1992) "On the Social Optimality of Liquidated Damage Clauses: An Economic Analysis," *Journal of Law, Economics, and Organization*, 26, 280-305.

[3] Edlin, A. S. (1998) "Breach Remedies," in *The New Palgrave Dictionary of Economics and the Law* by P. Newman (ed.), Macmillan: London.

[4] Edlin, A. S., and S. Reichelstein (1996) "Hold-ups, Standard Breach Remedies, and Optimal Investment," *American Economic Review*, 86, 478-501.

[5] Hall, R. E., and E. P. Lazear (1984) "The Excess Sensitivity of Layoffs and Quits to Demand," *Journal of Labor Economics*, 2, 233-257.

[6] Myerson, R. B., and M. A. Satterthwaite (1983) "Efficient Mechanisms for Bilateral Trading," *Journal of Economic Theory*, 29, 265-281.

[7] Rogerson, W. (1984) "Efficient Reliance and Damage Measures for Breach of Contract," *RAND Journal of Economics*, 15, 39-53.

[8] Shavell, S. (1980) "Damage Measures for Breach of Contract," *Bell Journal of Economics*, 11, 466-490.

[9] Spier, K. E., and M. D. Whinston, (1995) "On the Efficiency of Privately Stipulated Damages for Breach of Contact: Entry Barriers, Reliance, and Renegotiation," *RAND Journal of Economics*, 26, 180-202.

[6]MS also characterize a direct mechanism with an arbitrator that is incentive-compatible, individually rational, and also maximizes the arbitrator's expected profit. This mechanism does not achieve ex post efficiency.